Correspondence

Increased augmentation index and systolic stress in type 1 diabetes mellitus

Sir,

Wilkinson et al.\(^1\) have shown that type 1 diabetic patients have increased augmentation index, which is an indicator for increased systemic arterial stiffness. These findings were in contrast to our observations in a group of 46 consecutive type 1 diabetic patients and 51 controls, who were referred to the Royal Infirmary Leicester, UK.

Forty-six type 1 diabetic patients (30 males) with mean age 38 (SD 12.8) years, BMI 27 (5.3) kg/m\(^2\), mean heart rate 78 (14) bpm, mean blood pressure 95 (9.8) mmHg, mean diabetes duration 16 (10.2) years and HbA\(_1c\) 9.8 (1.8)% were compared with 51 well-matched controls (26 males) with mean age 39 (12.4) years, BMI 25 (3.9) kg/m\(^2\), mean heart rate 71 (10.4) bpm and mean blood pressure 92 (12.9) mmHg. In the diabetic group, 14 smoked and in the control group three were smokers. The same technique\(^2\) as in the above-mentioned study was used to determine aortic augmentation and central pressure. The results are presented in Table 1, where we use the same abbreviations as Wilkinson et al.

A significant difference (at the 5% significance level) between both groups was observed for the TII, SVI, PPP:CPP, DPTI, Diastolic duration/ms and Ejection duration/ms variables when compared using t-tests. On the basis of multiple stepwise regression analysis, all the unadjusted differences

### Table 1.

<table>
<thead>
<tr>
<th>Summary data</th>
<th>Unadjusted differences</th>
<th>Adjusted differences</th>
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<tbody>
<tr>
<td></td>
<td>Controls</td>
<td>Diabetics</td>
</tr>
<tr>
<td>Alx(%)</td>
<td>15.0 (13.2)</td>
<td>11.2 (12.4)</td>
</tr>
<tr>
<td>TTI (mmHg.s.min(^{-1}))</td>
<td>2148.1 (527.0)</td>
<td>2354.1 (421.2)</td>
</tr>
<tr>
<td>DPTI (mmHg.s.min(^{-1}))</td>
<td>3374.5 (527.0)</td>
<td>3387.0 (378.3)</td>
</tr>
<tr>
<td>SVI (%)</td>
<td>162.5 (31.3)</td>
<td>148.2 (30.5)</td>
</tr>
<tr>
<td>CSBP (mmHg)</td>
<td>109.3 (16.9)</td>
<td>112.8 (12.7)</td>
</tr>
<tr>
<td>CDBP (mmHg)</td>
<td>78.0 (11.2)</td>
<td>80.8 (9.7)</td>
</tr>
<tr>
<td>CPP (mmHg)</td>
<td>31.25 (9.04)</td>
<td>32.00 (10.43)</td>
</tr>
<tr>
<td>PPP:CPP (ratio)</td>
<td>1.44 (0.19)</td>
<td>1.52 (0.21)</td>
</tr>
<tr>
<td>Diastolic duration (ms)</td>
<td>563 (122)</td>
<td>497 (130)</td>
</tr>
<tr>
<td>Ejection duration (ms)</td>
<td>305 (21.6)</td>
<td>294 (23.6)</td>
</tr>
</tbody>
</table>

Values are mean (SD). Differences are adjusted for heart rate, height, age and gender (when such variables were significant at the 5% level).
between diabetic and non-diabetic patients became insignificant when including the covariates, which included heart rate, in the analysis.

Our study group differs slightly from that of Wilkinson et al. but despite our diabetic patients being older, having longer duration of diabetes and higher smoking rates, no increase in Alx has been observed. In fact, the opposite was true: diabetic patients had lower Alx because of higher heart rate, which corresponds to the shortly-to-be-published paper of Wilkinson et al. We also found a significant difference in the systolic pressure time integral (TTI) and diastolic pressure time integral as marker of subendocardial viability (SVI). However, these differences became insignificant when heart rate was included in the analysis. In addition, it is highly unlikely that our contrasting results can be explained by errors in the clinical measurements, since they were performed by the same two trained observers, who have evaluated (and demonstrated) the reproducibility of the applanation tonometry device in a previous study.

Our working hypothesis when we began our study was that we would find increased augmentation in type 1 diabetes, consistent with the hypothesis that these patients have accelerated vascular ageing. Our findings did not confirm our hypothesis. These divergent findings between our two studies cannot be accounted for by marked differences in the demography of the study populations or the techniques used to assess augmentation, which were the same and are readily reproducible. Further work is clearly necessary to clarify the impact of diabetes mellitus on conduit artery function.

A. Siebenhofer  
University of Graz, Austria  
A.J. Sutton  
Department of Epidemiology and Public Health  
University of Leicester, UK  
B. Williams  
Cardiovascular Research Institute  
Leicester, UK

References


Sir,

Siebenhofer et al. present their previously unpublished data concerning arterial stiffness and central haemodynamics in patients with type 1 diabetes mellitus. We hope that its publication in this non-peer-reviewed format will not preclude its future publication and critical appraisal. As discussed, their findings are at variance with our own observations previously published in QJM. We reported a significantly higher augmentation index (a measure of systemic arterial stiffness), estimated aortic pulse wave velocity (a measure of aortic stiffness), and tension time index (a measure of central systolic load) in subjects with type 1 diabetes compared with matched controls. In contrast, Siebenhofer et al. failed to find any difference in augmentation index between diabetics and controls. Moreover, although the tension time index was higher amongst the diabetic patients with univariant analysis, the association was no longer significant after adjustment for potentially confounding factors such as heart rate.

The reasons for the disparity between the two studies are, as discussed by Siebenhofer et al., not immediately apparent, especially as the same technique for recording and analysing pressure waveforms, pulse wave analysis, was used in both studies. In addition, both studies had reasonably well-matched diabetic and control groups, and although the augmentation index of the control subjects was considerably higher in the study of Siebenhofer et al. compared with ours (15% vs. 0%), this is consistent with the higher mean age of their control group (39 vs. 30 years). Moreover, since both reports used paired Student’s t-tests for initial data analysis, the variant findings cannot be explained on the basis of different statistical approaches.

Although not discussed by Siebenhofer et al., one other group had addressed the important question of systemic arterial stiffness in type 1 diabetes mellitus, using the same pulse wave analysis technique of O’Rourke and colleagues. Brookes et al.2 studied a larger group of 89 young subjects with type 1 diabetes and 95 controls, and found a significant association between diabetes and arterial stiffness, as assessed by the augmentation index. They also reported that subjects with diabetes had a significantly higher central systolic pressure than controls.

It is an old notion that the blood vessels of the diabetic patient function as though they are at least
10 years older than the patient. This is supported by a considerable body of published data amassed over the last 40 years, demonstrating increased arterial stiffness in diabetic patients as, indeed, previously discussed in detail by one of Siebenhofer’s co-authors. Abnormalities in the arterial pressure waveforms of diabetic patients were first reported by Lax and Feinberg in the 1950s, and have subsequently been confirmed by others using a variety of techniques. Increased regional large-artery stiffness in patients with type 1 diabetes has also been demonstrated by assessment of the pulse wave velocity and various ultrasound-derived indices, and by examination of post-mortem tissue.

In conclusion, the results of Siebenhofer et al. are in disagreement with our own, but we would suggest that our data are supported by those of Brookes et al., and the vast majority of published data. Perhaps, rather than undertake further small studies investigating abnormalities of the pressure waveform in patients with type 1 diabetes mellitus, it is time to undertake larger studies to assess the importance of such measurements as a predictor of outcome.

I.B. Wilkinson
Clinical Pharmacology Unit
University of Cambridge

J.R. Cockcroft
Department of Cardiology
University of Wales College of Medicine
Cardiff

D.J. Webb
Clinical Pharmacology Unit and Research Centre
University of Edinburgh

References


